"The Arctic Coast from the Mouth of the Ti-her-Yuak River to the Mouth of the Coppermine River

The coast-line near the mouth of the Ti-her-yuak River is formed of crystalline or metamorphosed rocks of the same general character as those of which so much was seen on the route northwards from the Ti-her-yuak Lake. A single specimen was taken close to the river mouth; for if a hundred specimens were collected they would all differ slightly but immaterially, and one was sufficient to establish the important fact that the pre-Cambrian rocks of North America extend to the Arctic coast at this place. [262]

On commencing our journey westwards along the coast over the ice, and with the mainland shore to the south, we found that small rocky islands almost destitute of vegetation were numerous, scattered at a little distance from the shore of the mainland, which appeared as a long, low, undulating ridge of rocks.

There was much evidence of the great ice-sheet having moved in a northern direction here, as there were deep grooves scooped out, and the rock surfaces of the islands were much striated. It was also noticed that the rocks, similar to those on the mainland, were all abruptly broken off to the north.

On the 18th of May, quartz rock and granitic or gneissose rocks with much quartz were conspicuously observable in bands and patches, with smoothings and deep striations.

Continuing westwards to White Bear Point in latitude 68° 5' 27", we found the coastline very low but stony, with rocky knolls and intervening small flats. The rocks were smoothly glaciated, and quantities of small loose stones and sand were seen.

On the 25th three Eskimo met us with a few copper articles and a lump of native copper about 2 lbs. in weight. This native copper, from which needles and other domestic implements are made, is obtained by the Eskimo from islands to the north--Victoria Land, and other localities in higher latitudes.

At the portage across Kent Peninsula we found the rocks still similar, but giving indications of change of surface level in very recent times, as beds of recent marine shells (1) occur at about ten feet above high-tide level. Similar patches of shells were seen

1. Saxicava artica and Cardium islandicum.

until June 10th, and some occur among the soil or gravel on hill-slopes as high as 500 feet above sea-level.

On the 31st of May we crossed the divide on the Kent Peninsula portage and found the country very hilly and rocky. There was one isolated hill of quite a precipitous character. Photographic views are given to show the features of this area. During our stay here, latitude 68° 32' 46", on the 2nd of June, I ascended the precipitous hill, Har-li-ar-li,

which is 360 feet high and has a flat top. The rock was a good deal broken on the surface, and showed no evidence of the passing of an ice-sheet.

The rocks, however, had now changed in character, as the granitic or gneissic rocks that had characterised the region through which we had passed from the Ti-her-yuak Lake in latitude 66° had given place to a decidedly igneous rock, which proves to be a coarse-grained ophitic dolerite. (See Description of Rock Specimens, No. 4.) There were, however, at this place transported boulders of the previously traversed rocks.

On the 3rd of June, near a lake on the isthmus of the Kent Peninsula named It-ĭb-lĕr-yuak, many patches of marine shells were observed. The shells were similar to those seen on the 30th of May [263] at Portage Inlet. The occurrence of marine shells on coastal slopes may be accounted for otherwise than by coast elevation, for sheets of shore ice are capable of pushing up portions of the seashore in a frozen condition, and thus shells may be left on the land at considerable elevations above the sea-level.

On June 5th we found the country rock like that at Mount Har-li-ar-li. It was here to be seen in a horizontal sheet and much jointed. At about four miles distance we again observed the pre-Cambrian gneissic rocks, which doubtless underlie the sheets of dolerites.

At the mouth of the I-lu Inlet, where we arrived on June 6th, the land is low on the north, but high and precipitous in many places on the south shore.

There are two unusually lofty hills on the south-western shore of I-lu Inlet, one named I-ta-wing and the other U-wei-u-ullig, the latter of which is the highest, having an elevation of about 6000 feet, of which about 150 feet is formed by a perpendicular rock precipice.

On the 7th, in latitude 68° 12' 07" the coastal land was high and rocky and even mountainous in character, and on the 8th we camped at a small bay, overlooked by a hill that I ascended on the 9th, and found to be 840 feet above sea-level.

A long slope of flat rock ascends to within 150 feet of the summit, and this is a flesh-coloured granitic mass dipping west at an angle of about 30°. It is a felspathic grit containing much well-rounded quartz in grains with largely decomposed felspar and scaly secondary mica. (See Description of Rock Specimens, No. 5) The surface of the rock is smoothed and grooved by ice action, but not striated. The crest or summit ridge of 150 feet is formed by a doleritic rock similar to No. 4 on Mount Har-li-ar-li and to that in the vicinity of It-ĭb-lĕr-yuak Lake. The rock on this summit is a hornblende diabase. (See Description of Rock Specimens, No. 6.) It is also smoothed and grooved, but not striated.

It is impossible to say in which direction the ice moved at this place. The rocks where precipitous have their faces to the east, west, south, and north-west.

10: Hanbury--261-267 (1901-02) 1904 Copper Eskimo-5
116, 133

On the 10th of June I examined a precipitously-cut hill about four miles from our camp. The cliffs faced due west, and were opposite to the face of the 840 feet hill that I had ascended the day before, and from which I had obtained the rock specimen No. 5. Between the two hills extends a valley of about three miles in width, containing two long narrow lakes, and through the valley the surface water flows northwards. The rock forming the valley bottom is a fine red sandstone consisting of rounded grains of quartz with a small amount of cementing material. (See Description of Rock Specimens, No. 7.)

This sandstone rock is in places conglomeratic, and is there full of quartz pebbles. The felspathic grit (No. 5) and the red sandstone (No. 7) seem to pass into each other at a certain altitude, while the summit capping of the hill is the hornblendic diabase (No. 6). [264]

It appears to me that the valley between these two hills has been formed by ice-action, which has taken away nearly all the doleritic rock of the summit levels, leaving only the crests of the two hills, and No. 5 has been removed also, except where it remains between No. 7 and No. 6, while the sandstone rock, No. 7, remains to form the bottom of the valley. It is to be noted that the felspathic grit, No. 5, contains quartz pebbles as well as the sandstone. Briefly, it may be stated that the crests of the somewhat high hills in this area are composed of the volcanic doleritic rock, No. 6, while at lower levels is the grit, No. 5, and at the bottom of the valleys is the sandstone, No. 7, though, it should be added, this last rock is not always exposed.

I could not ascertain in which direction the ice-sheet had moved, but from the conspicuous smoothing and grooving, it is evident these hills have been covered by it; and it seems to me remarkable that the whole of the uppermost rocks have not been removed by the powerful glacial action to which they were subjected. Possibly they were exposed before the ice-sheet made a general movement.

The origin of the small, flat, generally circular, gravel terraces, which have been noted by every one who has visited the Barren North Land, is not very apparent. I noticed and watched the débris, gravel, grit, and sand that issue from a deep bank of snow. It ran down and was settling in and filling up a small circular hollow in the ground. One might say that a miniature moraine from a miniature glacier, the snow-bank, was terminating in this hollow. It now appeared to me that the ice-sheet had moved in a southerly direction over this area.

On the 13th the land seen five miles to the south was very rugged and rocky, and it continued so on the 15th, when we traversed the portage across Cape Croker, where we found a fine-grained granitic or gneissic rock.

On the 16th we reached Barry Island, which one of my Eskimo had described as the best place for copper. He now said copper was more plentiful on an island six or eight miles north of Fowler Bay. However, two pieces of native copper were found in the

evening.

The next day we searched for copper on the north-west shore of the island.

The main rock of the island is a fine-grained basalt which Dr. Flett described as granular, holocrystalline, and non-porphyritic, and a good deal decomposed. (See Description of Rock Specimens, No. 10.) The rock, although hard, is easily broken in all directions by a tap of the hammer. The summit of the island is, however, formed of a rock of the character of No. 6, and is described as coarse-grained ophitic dolerite with plagioclase and augite, and perhaps a few grains of olivine. The ophitic structure is very perfect. (See Description of Rock Specimens, No. 11.) [265]

The underlying basalt dips west at an angle of about 25°, and it is in this rock that the native copper occurs. The copper is plentiful, for the quantity we obtained was found after but a brief search, and on a neighboring island, Kun-nu-yuk, a mass of copper had just been found, so large that a man could hardly lift it. There also copper is often found in the tide-way. The whole of the lower levels on Barry Island are covered with débris from the basalt, and where the rock has been disintegrated by weathering, copper has fallen out, so that flakes of the metal may be found along the sea-shore. In many places, too, green patches indicate that nuggets or flakes of copper have recently fallen out from their matrix.

The copper-bearing rock also contains crystalline quartz, some of which forms

beautiful anethystine veins, of which some specimens were taken. There is here some further evidence of coastal elevation in the occurrence of saucer-shaped lines of water-worn débris at from twenty to forty feet above the present level of high tides.

The question whether it would ever pay to work the native copper of these regions remains for the consideration of experts. I have always understood that native copper occurring in small flakes or nuggets and sparsely distributed, is of but little practical value, and that copper can only, as a rule, be successfully worked from ores that are rich and easy of access. Much depends doubtless on its abundance and regularity of distribution. This island, Barry Island or Iglor-yu-ullig, is several miles in length, and perhaps three or four miles across. The Island to the south-south-east, Kŭn-nu-yŭk, is still larger, besides which there is an island to the south-west which has given much copper, and there are copper-yielding islands to the north. The copper-bearing formation holds good everywhere except on the summit cappings of the islands.

On the 18th of June we reached the most easterly land of Bathurst Inlet, which is very hilly and rocky, some of the hills attaining an altitude of 1500 feet. Between the hills are grassy flats, but at present they were but swamps.

On the 23rd, on our way across Bathurst Inlet, we approached a flat-topped precipitous island very much resembling a kopje. When near to it I noticed a change in its

rock formation, and saw that there was a bed of limestone about fifteen feet thick underlying a capping of igneous rock of about 20 feet thickness.

On further examination I found the limestone which is thinbedded and horizontal, in places 60 feet thick. The summit, igneous rock, is an ophitic dolerite similar to the cappings of the islands and hills previously seen. (See Description of Rock Specimen, No. 13.)

Although fossils were diligently searched for, none were found in the limestone.

The dolerite is columnar in places, and large masses and much smaller débris have fallen to the base of the precipitous cliffs formed [266] by the limestone and dolerite. Southwards from the island mass a long spit of the dolerite rock projects into the sea, and it is seen to be very much smoothed and grooved, and the striae, all trending to the south-south-east, are very numerous.

About five miles beyond this limestone island we passed a small basaltic island on which two pieces of copper ore were picked up. It seems as if copper is to be found wherever this basalt occurs.

On the 25th June we camped on the north point of Lewis Island.

With the exception of some precipitously-cut rocks near our camp, this island is formed of the same partly-decomposed basalt as Barry Island. It is described as fine-grained, granular crystalline, decomposed basalt. (See Description of Rock Specimen, No. 15.)

Although we did not find so much copper here, the green marks on the rocks were more numerous, but we did not spend an hour altogether in the search. One of our Eskimo knew of a large mass of copper on the south-west shore of the island, which he stated to be as much as five feet in length and three inches thick. It protruded from the rocks under the water it was said, but there was too much ice for us to find the copper. A piece of quartz with copper ore and native copper was picked up on the seashore. Another specimen of the copper-bearing rock here is decomposed basalt, fine-grained, and not unlike No. 15, but vesicular. (See Description of Rock Specimen, No. 17.)

In the bays of this island a regular succession of apparently old shore-lines can be seen. There are as many as eight, and although there are no shells, the fragmentary débris gives evidence of being water-worn.

On the 27th we rested at the north-west point of Lewis Island, where we again found the copper-bearing basalt, and accordingly we commenced a search that resulted in our collecting about 2 lbs. weight of copper. The metal appeared to be very persistent in its occurrence in the partly decomposed basalt of which all the islands we passed that day consisted. The flakes of copper seemed to be always vertical when in their rock matrix. The rocks of this island, where they are not disintegrated, are well smoothed by glacial action, and the striae are numerous and distinctly trend south and south-east.

Cape Barrow was reached on the following day, and this prominent headland, pointing due north, we found to consist of the felspathic gneissic rock of which so much had been seen. It is here very red and handsome in appearance, and is rounded and smoothed.

The islands lying off the Cape are basaltic, and the rock appears to have a columnar structure, and I think it overlies a bed of limestone. The precipitous cliffs of these islands are very similar to those of the limestone island previously seen. The land behind the coast-line is here very rugged. [267]

On the 29th June we arrived at a place called Ūt-kūs-kĭk, where there is a remarkable rock from which the Huskies have for generations made their kettles. The mass of this rock, which we may call kettle-rock, was situated about five miles from the site of our camp, and occurred as an enclosed mass in the red granitic-looking rock. It is so soft that it can be easily cut with an axe, and is of a greenish grey colour with a smooth steatitic feel. The rock is indeed a talc chlorite schist. (See Description of Rock Specimens, No. 18.)

The country at this part of the coast is rocky in general appearance, but grassy valleys, now somewhat boggy, abound.

On the 3rd July we encamped on the south-east side of Gray's Bay. The land forming the opposite and northern side of the bay is a promontory terminating in a point to the north-east, off which lies Hepburn Island.

Our camp was on the pre-Cambrian gneissic rocks, but on the promontory across the bay four miles distant and four miles from the north-eastern termination, we found red sandstone underlying what resembled sheets of basaltic rocks which, with precipitous cliffs, prevailed at the surface both throughout the promontory and on Hepburn Island. The rock is described by Dr. Flett as fine-grained, well-foliated hornblende schist. (See Description of Rock Specimens, No. 19.)

We found the land near Epworth Point on the 6th very rocky, but the rocks much smoothed and striated.

Further west, precipitous basaltic rocks are seen overlying the felspathic granitic or gneissic rocks, and at two places we observed an occurrence of the talcose kettle-stone.

On the 8th of July we reached a part of the coast about twenty-seven miles west of Epworth Point, where the coastal country may fairly be called beautiful, with long, grassy, gently-rising slopes extending inland from sandy and gravelly shores that form the coast-line.

The rocks seen were slates with good slaty cleavage, horizontally bedded and capped by basaltic rocks, of which large detached masses lay balanced on narrow ledges of the slate.

On June 15th the hills on the other side of the Coppermine River were clearly visible

from the rising ground at the back of our camp, and they did not appear to be very distant.

Doleritic rocks again formed the summit levels, and consisted of coarse-grained ophitic dolerite with augite. (See Description of Rock Specimens, No. 21.)

On the 19th of July we reached the mouth of the Coppermine River.

The country we had seen along the coast for several days was of a very pleasing character in the Arctic summer, long, grassy slopes rising from the sea-shore, with occasional patches of willows that stood out conspicuously owing to their extreme greenness."

10: Hanbury--268-270 (1901-02) 1904 Copper Eskimo-1-4
116, 133

'ROCK SPECIMENS FROM THE NORTHERN PART OF CANADA--FLETT

1. A decomposed gneiss, consisting of quartz, felspar, and chlorite after biotite. The felspar is mostly orthoclase, but plagioclase is also present, and decomposition of these two minerals has given rise to much secondary mica. Everywhere the rock shows abundant signs of mechanical deformation, and cataclastic structure is highly developed. The quartz is often crushed to powder, the felspar broken and torn up. Epidote and chlorite are frequent, probably both secondary after biotite.

2. A peculiar rock which may perhaps be best described as a hypersthene biotite granulite. It consists, for the most part, of orthoclase, plagioclase, and quartz. The quartz was proved to be uniaxial and positive, and forms lenticular or elongated masses which give the rock an indistinct parallel structure. It is not gneissose, however, but looks massive in the hand specimen. In addition to the minerals named there is a small quantity of biotite and of hypersthene. The last-named mineral was recognised by its cleavage, straight extinction, dichroism, and polarisation. It shows the usual decomposition into bastite. It is not common in rocks of this kind. Apatite, zircon, and iron are present as accessories.

3. Decomposed, fine-grained olivine basalt or anamesite, consisting of lath-shaped plagioclase and small grains of augite with a small amount of olivine which has passed into dark brown serpentine. There is also a good deal of iron oxide and secondary

limonite.

4. Coarse-grained, perfectly ophitic dolerite, with large irregular plates of purplish-brown augite, enclosing many small elongated plagioclase felspars. It does not seem to have contained olivine, and is a very fine example of ophitic structure.

5. Felspathic grit, containing much well-rounded quartz in grains which are sometimes 2 mm. in diameter, together with felspar, mostly somewhat decomposed. The quartz is granitic and not frequently sheared, and the cementing matrix between the grains [269] is full of fine, scaly, secondary mica. There are a few fragments which seem to have been derived from a felsitic rock.

6. Hornblendic diabase. Consists of plagioclase, felspar, and hornblende, which is partly uralitic, and probably after original augite, partly compact and apparently primary. There is also a little biotite and large plates of ilmenite, needles of apatite, &c. Most probably this was once an ophitic dolerite with augite and plagioclase, but if so the augite is entirely uralitised. See 13.

7. Fine quartzose sandstone, composed of rounded grains of quartz with a small quantity of cementing material. It contains also a few bits of felspar and grains of iron oxide.

10. Fine-grained, granular, holocrystalline, non-porphyritic basalt, a good deal decomposed. The augite has all weathered into chlorite and other secondary products. The rock does not seem to have been ophitic. Not unlike specimen marked 3.

11. Coarse-grained ophitic dolerite, with plagioclase, felspar, and augite, and perhaps a few grains of olivine. The ophitic structure is very perfect. In some ways this rock approaches gabbro, as the augite often has a diallage structure, but the ophitic character resembles rather that of the dolerites. It contains large irregular masses of ilmenite and a little biotite and apatite.

13. Ophitic dolerite, similar to the preceding, but more decomposed. There is a little biotite in this rock, and dark green hornblende, some of which is secondary after augite (uralite), but part is primary, and has formed on the surface of the original augite.

14. Coarse-grained pegmatite, consisting of quartz, orthoclase, plagioclase, and chlorite. There is also some fresh dark brown biotite and a little muscovite. The rock has been sheared, and the quartz is often broken up; in the hand specimen it has a somewhat gneissose character.

15. Fine-grained, granular crystalline, decomposed basalt. It consists of plagioclase, felspar, and small grains of augite, and is neither porphyritic nor vesicular. It has probably contained a little olivine, though that mineral is no longer present in the unaltered condition, but is represented by pseudomorphs of brown serpentine. There is also a good deal of iron oxide, partly weathered to limonite.

17. Decomposed basalt, fine grained and not unlike the preceding, but vesicular. The vesicles are filled with chlorite, quartz, and secondary sphene (?) after ilmenite, and a

peculiar feature of the rock is the occurrence of pale more felspathic zones around the vesicles. The rock has consisted originally of plagioclase and granular augite, but both these minerals are now much decomposed.

P. S. -- The mineral referred to above as iron oxide is really a copper ore filling veins and cavities. It is dark when fresh, but weathers into green malachite. (Soluble in HNO^3, giving green solution, precipitated by NH^3, and dissolves to form dark blue fluid on addition of excess.) [270]

18. Talc chlorite schist with scattered grains of iron oxide.

19. Fine-grained, well-foliated hornblende schist, consisting of small crystals of horblende, grains of felspar, and some epidote, and iron oxides.

21. Coarse-grained ophitic dolerite, with augite, olivine, and plagioclase felspar. The structure is ophitic. There are large plates of ilmenite and some apatite. The augite is weathering to chlorite. Olivine is scarce, and is decomposing into serpentine."

10: Hanbury--276-277 (1901-02) 1904 Copper Eskimo-1-3
116, 137

"FLORA OF THE ARCTIC COAST OF NORTH AMERICA: OGDEN BAY TO COPPERMINE RIVER (100°-115° W. Long.)

Collected by DAVID T. HANBURY, 1902. Determined by R. A. ROLFE, A. L. S. of the Royal Gardens, Kew.

Anemone parviflora, Michx.
Caltha palustris, L.
Papaver alpinum, L.
Parrya arctica, R. Br.
Cheiranthus pygmaeus, Adams.
(Hisperis Pallasii, Torr & Gray.)
Cardamine pratensis, L.
" digitata, Richardson.
Draba alpina, L. variety with bright yellow flowers.
Draba alpina, L., variety with
(Phaca aboriginorum, Hook.)
Hedysarum boreale, Nutt.
Astragalus sp. nova?
Oxytropis campestris, L.
" nigrescens, Fisch.
Dryas integrifolia, L.
Potentilla biflora, Willd.
" nivea, L.
" " var.
" *fruticosa, L.
Saxifraga cernua, L.

*Not included in Arctic North-Eastern America in Hooker's 'Distribution of Arctic Plants.'

pale yellow flowers.
Draba incana, L.
Erysimum lanceolatum, R. Br.
Silene acaulis, L.
Cerastium alpinum, L.
Stellaria longipes, Goldie.
Arenaria Rossii, R. Br.
" peploides, L.
(Honkeneja peploides, Ehrh.)
Lupinus nootkatensis, Donn.
(L. perennis, Hook., not of Linn.)
Astragalus aboriginum, Richardson.
Ledum palustre, L. forma decumbens.
Rhododendron lapponicum, L.
Pyrola rotundifolia, L.
" Hirculus, L.
" oppositifolia, L.
" tricuspidata, Rottb.
Epilobium latifolium, L.
Aster sibiricus, L.
Matricaria inodora, L.
(Pyrethrum inodorum, Sm.)
Arnica montana, L., var. angustifolia.
Senecio palustris, L.
Taraxacum officinale, Wigg.
Crepis nana, Richardson
Cassiope tetragona, L.
Andromeda polifolia, L. [277]
* Pedicularis capitata, Adams.
" hirsuta, L.
" sudetica, L.
Pinguicula vulgaris, L.

* Not included in Artic North-Eastern America in Hooker's 'Distribution of Arctic Plants.'

10: Hanbury--276-277
116, 137

(1901-02) 1904

Copper Eskimo-3

* Primula farinosa, L.
Armeria vulgaris, L.
Mertensia maritima, S.F. Gray.

Oxyria reniformis, Hook.
Woodsia glabella, R. Br.

* Not included in Arctic North-Eastern America in Hooker's 'Distribution of Arctic Plants."

10: Hanbury--293 (1901-02) 1904 Copper Eskimo
116, 141

MEASUREMENTS OF ARCTIC COAST ESKIMO

Height.	Girth of Chest.	Forearm.	Arm, Shoulder to Finger Tips.	Leg from Hip.	Length of Hand.	Length of Foot.	Sex.
5 feet 3½ inches.	37 inches.	6½ inches.	25 inches.	33 inches.	7 inches.	10 inches.	Male.
5 " 5½ "	38 "	6⅝ "	25½ "	34½ "	6½ "	10 "	"
5 " 6½ "	38½ "	6⅝ "	27 "	32½ "	7 "	10½ "	"
5 " 5 "	39 "	6⅝ "	27 "	32½ "	7 "	10½ "	"
5 " 6½ "	38½ "	6⅝ "	29 "	34 "	7½ "	9½ "	"
5 " 1½ "	36 "	6½ "	27 "	33½ "	7 "	10 "	"
5 " 1 "	...	...	...	...	...	...	Female.
4 " 10½ "	...	...	...	...	...	...	"
4 " 10 "	...	...	...	...	...	...	"
5 " 1½ "	...	...	...	...	...	...	"
4 " 10½ "	...	...	...	...	...	...	"

Taken near Ogden Bay in May 1902.